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## A SCORE OF EASILY PROPAGATED LILIES

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## INTRODUCTION

Eminent plantsmen have handled lilies most admirably and often during the last half century, with a knowledge of their species and varieties, habits and habitats, characters and characteristics, which has left little to be desired. The literature of the subject is already voluminous. This additional contribution has been prepared in response to the public demand for information as to how to increase stocks of lilies; also because of the belief that, notwithstanding the previous treatments, much can still be added to the available information on methods of increasing stocks and of producing bulbs for the market.

The directions for growing as laid down here are more or less empirically stated, not because these prescriptions constitute the only way, the preferred way, or even perchance the best way in all cases, but to emphasize a method of working with lilies which has succeeded under the conditions of the experiments and will succeed again if given a fair trial. There appears to be so little information publicly available as to how to produce stocks, and still less in the way of recorded experiences in this country, that it has seemed wise to be rather positive in the directions given in spite of a rather well-grounded belief that better ways of procedure than those here outlined may be found in some cases.



In the matter of the best time for vegetative propagation alone, there is yet much to be learned. The general advice given here is to propagate when the plants are in late blossom. It is not at all certain, however, that this is the best time in all cases or under all conditions. So far as the investigations have gone, propagation at this time is successful and satisfactory. Quite likely it may be as advantageously or even better done, with some species, at some other season. As an illustration, a good propagation has been obtained in a few cases four to six weeks before the time of flowering of the species, and instances are also recorded of successful propagations of imported bulbs in January. It is well to repeat that further investigation is necessary to determine the best time for this work, but propagation at the close of



FIG. 1.—Underground parts of the eastern Turk's-cap lily (*Lilium superbum*). There are shown bulbs which produced flower stalks the current year and the preceding year, and two which will give blossoming stems the next year. (Dug from nature in the District of Columbia by D. N. Shoemaker)

blossoming has proved successful and is advised unless a better one should be demonstrated by investigation or personal experience.

The lily grower should keep an open mind, investigate for himself, watch for new methods of doing things, and above all, keep on the lookout for hints which the plants themselves will furnish from time to time if he will but interpret them.

#### THE LILY BULB

The lily bulb consists essentially of two distinct parts; one, a basal structure which, in many cases, is plainly a rhizome (fig. 1) though in others less plainly so (fig. 2). From this basal structure arise alter-

nate layers of scales superimposed and overlapping one another, forming the other part which is the bulk of the bulb. From the under surface of the basal structure the true roots spring. These, except in dormancy, are large, often contractile in structure, copious, and prominent.

When dug the base of the stem of a Madonna lily which has recently flowered is prominent and is flanked on one side with large, rather loose scales. (Fig. 2.) On the opposite side of the stem is the larger, more solid portion of the bulb, containing progressively smaller and more delicate scales as the center or growing point is approached. It is from this point that the following year's stem develops. In Figure 2 the next year's stem is shown proceeding from a very comparable structure but separated by an underground rhizome from that of the current year.

In the case of bulbs which have not reached maturity, the whole structure consists of the growing point and surrounding scales, from the center of which continuously appear new leaves, the dilated bases of which form the successive imbricated scales, until the bulb gets large enough to throw a stem. (Fig. 3.)

The space between the old stem and the crown is very variable in different species of lilies. In the Madonna, as illustrated, it is short, so that the whole is included in one solid bulb; but in some lilies, like the eastern Turk's-cap, Leopard, Lemon, and others, the space is lengthened into a stock of appreciable dimensions, so that the portions which produce stems two successive years are really separate bulbs. These features are well illustrated in Figure 1.



FIG. 2.—Section of bulb of Madonna lily, showing growing point, indicated by arrow, on left of current season's stem

#### CLIMATE AND SOILS FOR LILY CULTURE

The ideal climate for the culture of the largest number of species of lilies is one having a uniformly low temperature and relatively high humidity. These two conditions, aside from soil characteristics, considered elsewhere, are the prime factors contributing to the best and most varied successes.

The Puget Sound region meets these two conditions very well, but its season is rather short, and portions of the region are subject to late spring frosts, which are injurious to many species. To avoid injury from these frosts it is necessary to give careful attention to air drainage and to the selection of situations which are least frosty. The matter of shortness of season is not of apparent importance except in cases wherein it is necessary to produce seed in late-flowering species. Even this difficulty may be overcome at times by maturing the seed on cut stems in vases of water under artificial heat.



On account of these two main climatic requirements, a maritime situation in any location has decided advantages in both equability of temperature and humidity. The advantages are not alone in the growing, but are especially noticeable in the handling of the bulbs while out of the ground. Any region in which the bulbs do not wilt readily when out of the soil has decided advantages, for it is at this time that the bulbs deteriorate in quality most rapidly.

The writer has not found that lilies are particularly exacting as to the types of soils in which they do best, except that they require a

friable loam. If this be considered exacting, then lilies are exacting, for success can seldom be attained on bakey, plastic clays or lean, loose sands, unless such soils are ameliorated by the incorporation of an abundance of organic debris, which changes their texture.

At the time this is written, the half acre of lilies in the planting at Bellingham, Wash., is located in a strip of land about 350 feet long. In its native condition one end is a heavy dense clay which plows up in big clods, slacking and crumbling on exposure to the drought of summer but running together again upon the advent of winter



FIG. 3.—Scale reproduction in Madonna lily (right) and Nankeen lily (left). Planted July, 1925; photographed April, 1926

rains, and the opposite end is Lynden gravelly loam. The whole plot has received the same treatment preparatory to growing the lily crop. It was well and frequently tilled, and two very heavy crops of rye and vetch were incorporated after having been allowed to get rather hard before being plowed under. The different varieties of lilies have been planted without reference to their specific requirements. It happens that most of the Madonna, Nankeen, and Umbellatum lilies were planted on the heavier soil. Small lots of all of these species are also on the lighter soil. The lighter soil does not produce as robust growth, and more attention must be given to keeping up moisture during the dry July–August period, but good stocks are grown on it.

On the Arlington Experiment Farm, Rosslyn, Va., near Washington, D. C., the culture has been on a coarse lean sand. It is the

writer's judgment that, in spite of strenuous effort in that direction, it has not been possible to incorporate enough organic matter to make this sand into lily soil, and that an attempt to accomplish this with large applications of stable manure has interfered in some cases with the health of the stocks. Although success has been had with the Regal, the Madonna has not thrived in this situation.

#### PREPARATION OF SOIL

It should be emphasized at the outset that the greater part of the culture for any crop of lilies should take place before that crop is planted and that the soil should be put into such condition that it will maintain to a very large degree both its porosity and tilth, as well as its ability to retain moisture, during that crop period, with a minimum of subsequent stirring. This means one thing—a large humus content, which is one of the essentials in the successful production of this crop.

It is needless to say that land for lily culture should be well and deeply tilled. In the Puget Sound experiment lily culture is now conducted on 1 acre of land, of which one-half is in crop at one time. The bulbs are dug every second year, which means that two very heavy crops of rye and vetch, allowed to develop to the late blossom or early milk stage, are incorporated in the soil. The criticism has sometimes been made that this is wasteful of land. Without going into a detailed defense of this practice, it may be said that it is not at all certain in the writer's mind but that this is good commercial practice, unless it can be shown that humus content and fertility can be brought up more cheaply.

#### PLANTING

The tendency in the United States is to discard the bed system of planting in favor of planting in rows. Both systems have their devotees, and each has its advantages and disadvantages. Which will eventually gain the ascendancy remains to be seen.

If the row method be employed, the land may be laid out with a small plow, single shovel, cultivator, middle burster, or some similar tool. The large bulbs should then be set mostly with a trowel and the small ones strewn along the row without definite placement. The large bulbs are placed 3 to 6 inches apart and the small ones an inch apart or even less. The furrows may be filled up in various ways, as seems most convenient.

The method used in planting in beds does not differ essentially for a great variety of bulbs. In general, the beds are laid off 3 feet wide, as long as the width of the plot, and alternating with 18-inch paths. The soil is thrown out of the first bed to a depth of about 4 inches. The bottom is then raked to a level and marked across with rows 6 or 9 inches apart, depending upon the size of the bulbs to be planted. Six-inch rows are used whenever possible, but the majority of full-sized lilies grow so large as to require a 9-inch row.

Again the setting of the bulbs is similar to the same operation in other stocks, except that in the planting of large lily bulbs—especially if the roots are on them—it is necessary to set with a hand trowel in order to make them stay put and also in order to get them placed at the proper depth.

The bulbs in a bed are covered with the soil excavated in the opening of the next bed, and so on over the plot. Large lily bulbs, as stated above, may be planted in rows 9 inches apart, and there may be from five to nine of them planted to the row. Small bulbs of practically all varieties are most advantageously set in 6-inch rows and 9 to 50 of them put to the row. The smaller sizes are strewn along without definite placement, but always in rows.

Scales are planted like the bulbs except that the beds are excavated only about 2 inches deep and 50 to 100 or more scales are planted to a 6-inch row.

### CULTIVATION

The bed method of planting presupposes little or no cultivation. Weeds are removed by hand, and a hand weeding tool of some kind is commonly employed to barely scratch the surface in the spring as weed seeds germinate. The paths between the beds are kept cultivated with a wheel hoe to counteract the packing of the soil.

In the row method of handling, cultivation must be practiced as often as necessary to keep down weeds and maintain tilth. For horse cultivation 36 inches of space is necessary between the rows, and for wheel-hoe cultivation 18 to 30 inches.

### ROW AND BED METHODS CONTRASTED

The row method of handling permits of keeping down weeds with horse-drawn implements, and this is its chief advantage. If high humus and high fertilizer content are maintained, there is decided economy in a thick and exhaustive cropping over a small area rather than a thin, light cropping over a large one. It may be economically possible to put one-half acre into proper physical condition to grow 50,000 bulbs, while not profitable to put 1½ acres into similar condition to grow the same number. It would seem that the thick planting is more economical of both fertility and mulching materials.

In row planting and horse cultivation, care must be exercised not to interfere with the stem roots. This necessitates hand weeding in the rows. This does not, however, apply so much to the Madonna or the Nankeen, which do not generally produce stem roots. But in the case of the Easter lily, where it is desirable at times to increase the stem propagation, it may be advantageous to plant in rows so that the banking of the soil around the stems can be practiced from the time the plants come into blossom.

### FERTILIZERS

Animal manure, properly applied, is recommended as the best possible fertilizer for lilies, if the grower is sufficiently expert and careful in handling it. If a choice is offered, cow manure is preferable on account of its slower action. In these experiments stable manure has been employed frequently. Pulverized sheep manure has also been used, at the rate of 30 pounds to a bed 3 by 40 feet, as a top dressing a few weeks after planting.

At other times, when the crop was to remain two years, bone meal at the rate of 1,500 to 2,000 pounds to the acre has been thoroughly



incorporated in the bottom of the excavated bed at planting time. If it is seen that the available nitrogen is low, tankage may be substituted for 2 to 5 per cent of the bone meal. Partially rotted stable manure is commonly employed as a top dressing after the plants are thoroughly rooted.

While animal manures are unhesitatingly recommended, certain precautions are necessary. They should not be incorporated with the soil at planting time, for there is too much danger that, owing to poor mixture, there may be lumps of the manure too close to the bulbs. This always means disaster.

The ideal way is to apply the manure the preceding year to vegetables or other intertilled crops. If the land can be spared, nothing can be better than to apply manure liberally to a green cover crop to be turned under four to six weeks before the lilies are planted.

If chemicals are considered necessary, they may be safely used in the form of complete fertilizers comparatively high in both phosphoric acid and potash. On Puget Sound, where soils are especially low in phosphoric acid, this element has been increased by the use of superphosphate applied mostly as a top dressing and disked in on top of the cover crop of rye plowed under six weeks before planting the lilies.

It may be that the safest thing for the average inexperienced grower under present conditions is to depend for his fertility in lily culture on cover crops supplemented by artificial manures in which linseed, cottonseed, or soy-bean meal or some other organic material furnishes the nitrogenous ingredients.

The Bellingham (Wash.) situation, it should be remembered, was recently in forest. The lilies have been grown both on areas which have received 2 tons of ground limestone to the acre and on those which have received none. No carefully checked comparisons have been made, but the lilies have grown satisfactorily on both soils and, so far as observed, as well on the one as on the other.

### DIGGING

The digging of lilies is done the same way as that of Dutch bulbs, with a short-handled spade. The bulbs are so easily bruised and injured that it is doubtful whether any other method than hand digging will be efficient. A spading fork also makes a good digging tool. At Bellingham, Wash., however, the crew are so accustomed to working on their knees with the short spade in the digging of Dutch stocks that it comes very natural to dig lilies the same way.

Before starting to dig mature stocks of lilies the stems are gotten rid of either by jerking them out (pl. 6, C) or more often by mowing them with a scythe (pl. 7, A).

Any soil adhering to the roots is shaken off carefully without injuring the bulbs, which are placed in containers to be carried to the bulb house to be worked over and sorted. The hand screens, which are shallow, wire-bottomed boxes for screening out soil from Dutch stock, are used here as receptacles only. Lily bulbs are never screened over a wire mesh.

In these investigations the lily crop has been handled mostly on a biennial basis. Naturally, the quantity of stock of most varieties has been limited. Often a start has been made with less than six bulbs,

from which stock was worked up as rapidly as information and skill in propagation permitted. Often under such conditions, especially when no stock was to be turned off, there was little choice between annual and biennial lifting.

The writer considers it unwise now to dogmatize on the length of time that a lily planting should remain undisturbed, but in spite of the oft-repeated injunction to amateurs that lilies should be left alone so long as they are doing well, he is convinced that two growing seasons is as long a period as a commercial planting can profitably be left undug.

Often, possibly as a rule, digging may take place annually. This applies especially to the Easter and Madonna lilies, but much will depend upon circumstances. It will depend on whether the bulbs have attained the required size, whether they are spaced properly to acquire such size in another year, whether they have or can be furnished sufficient fertility in their present positions, and whether the variety dealt with is best adapted to the annual or the biennial method of handling. As an example, the Easter lily—both on account of its abundant natural propagation and its precocious autumnal growth in northern climates—will probably always receive annual lifting, while the Regal, if spaced about 6 inches each way from the seed bed, need not be dug until it reaches required size. No hard and fast rule is possible or desirable. Each species, in a measure, requires its own special treatment.

#### THE TWENTY SPECIES CONSIDERED

Possibly no two general growers of lilies would agree on the score of species of most easy culture. Some of those included here, possibly the majority of them, would be in every list, but not all of them. Experiences of different growers vary, and the conditions under which investigations are conducted are seldom identical, so the lists based upon different experiences must vary.

In explanation of this list it should be said that it is made up of species which have been a success in representative colonies at Bellingham, Wash., supplemented by a few grown on the Arlington farm. It is quite certain that the list treated would have been considerably modified had the writer happened to obtain a larger stock of other species six or eight years earlier. Many other species appear to be coming along just as well as the ones recorded here, but either the experience is of too short duration or the stocks are so limited that it seems unwise to make definite pronouncements regarding many of them yet. However, the exact species which are included in such a treatment do not matter so much. The methods of handling these will be serviceable and, it is hoped, applicable for the increase of stocks of most, if not all, of the others.

#### THE MADONNA LILY

(*Lilium candidum*)

The Madonna lily needs no introduction to any audience, for there is no lily the world over that is better or more favorably known. It is one of the oldest in cultivation, and none to-day is more widely or

more variedly used. It is universally recognized and grown throughout the Temperate Zones, mainly at present as a garden decoration, and sentimentally as an emblem of purity.

Its wide distribution and use indicate that it is a plant of easy culture and dependable multiplication. Its propagation is effected by several distinct processes, which, in the order of their importance, may be noted as follows:

1. The bulbs may be dug and scaled when the plants are in blossom or, possibly better, as soon as the flowers have faded. (Pl. 8, B.) If the weather is dry, the scales can be planted in the field 2 inches deep, 75 to 125 to the 6-inch row across a 3-foot bed, to remain one or two years, as most convenient. (Pl. 1, C, and fig. 3.) If the soil is wet or the season too late, the scales are better layered on a dirt floor in sand as dry as it can be obtained from the pit, or in other earth, in a frostless situation, to be planted in the field in the spring. They may also be incubated in much the same way as hyacinth bulbs are, in a moist atmosphere, where the temperatures can be held between 70° and 90° F., for 40 to 60 days, and then planted in the field. The scales rot if planted in a very moist soil, but if thoroughly calused and if bulblet formation has started they will withstand more moisture.

2. The stems can be jerked out of the bulbs as soon as the flowers have faded, and heeled in in the field with soil over the lower 12 to 15 inches only. Eighteen to twenty-four inches of the base of the stems may be layered in dry sand on a dirt floor and left for two or three months. (Pl. 2, B.) If convenient, the layering may be done under the benches of a greenhouse, in frames, or in other warm situations, when the bulblets will develop to 1 to 3½ inches in circumference in one and one-half months.

3. There is a natural reproduction by splitting up of the bulb, which serves admirably for any increase of stock desired by the householder, but the method is too slow for the commercial grower. (Fig. 4.)

4. Careful pollination will result in the production of seed which will grow readily, produce good plants the first year, rarely some blossom the second year, and hold its vitality perfectly, so that it can be successfully sown 12 to 18 months after maturity. The writer is indebted to A. Grove for the information that a form of the Madonna lily from Saloniki makes seed regularly in England. It has smaller flowers than the form in commerce.

The Madonna lily should be grown on well-drained soil. It should be planted shallow, only 2 inches deep, and should be dug and reset for propagation early, as soon as it has matured or even as soon

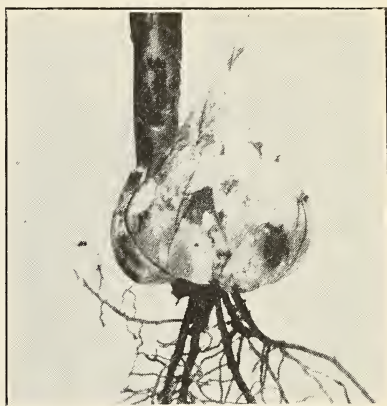


FIG. 4.—A typical merchantable bulb of Madonna lily dug the middle of July. It is three years from a scale and measures 9 inches in circumference



as the flowers have faded. Good culture for three years will produce commercial bulbs by any of the methods of propagation outlined.

**THE NANKEEN LILY**  
(*Lilium excelsum*; *L. testaceum*)

The Nankeen is a beautiful, vigorous, and robust lily and one of the rarest and highest priced of the older lilies in cultivation to-day. It is one of the Turk's-cap group and is fragrant and of a delicate nankeen yellow, well adapted to garden and cut-flower uses, and may be successfully forced. Its origin is not thoroughly understood, but it is usually referred to as an old garden hybrid between *L. candidum* and *L. chalcedonicum*. To support this view it may be said that in plant habit and form it agrees closely with the Madonna lily. In form of flower and inflorescence it corresponds with *L. chalcedoni-*

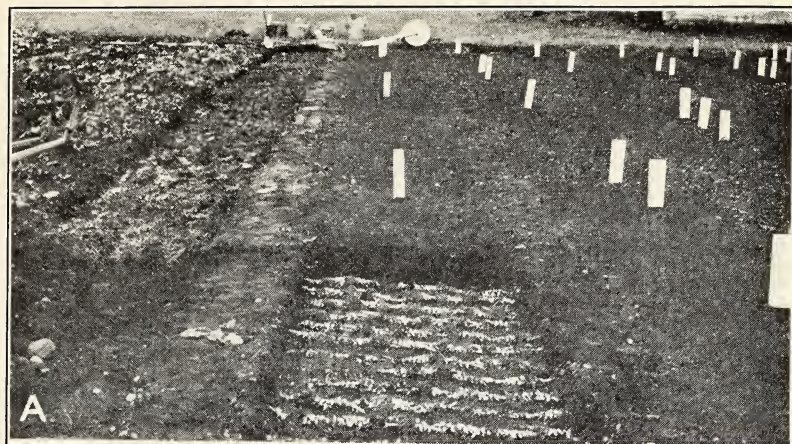


FIG. 5.—Typical Nankeen lily bulbs as dug in August, 1926. They were closely scaled in 1924 and again in 1925 and now measure 9 to 10 inches in circumference

*cum*, but in color of the flower it bears no resemblance to either of its supposed parents.

This lily is handled and increased in all respects in precisely the same manner as the Madonna and is even more easily grown. (Pl. 2, A, and figs. 3 and 5.) On Puget Sound, where it is found rather frequently in private gardens, its development is most phenomenal under ordinary conditions. An instance has been known where 45,000 bulbs of all sizes have been produced in eight years from 2 full-grown and 2 half-grown bulbs, and that without a full utilization of the possibilities of increase. (Pl. 1, A and B, and fig. 6.) It is possible to produce a hundredfold multiplication at a propagation from a maximum-sized plant and to propagate every second year safely. Again, a scale propagation in this lily can be successfully made at the end of the first year, so as to treble or quadruple the number of bulbs of the previous season. Three scales at least may be removed from the 1-year-old bulbs, and all will grow.

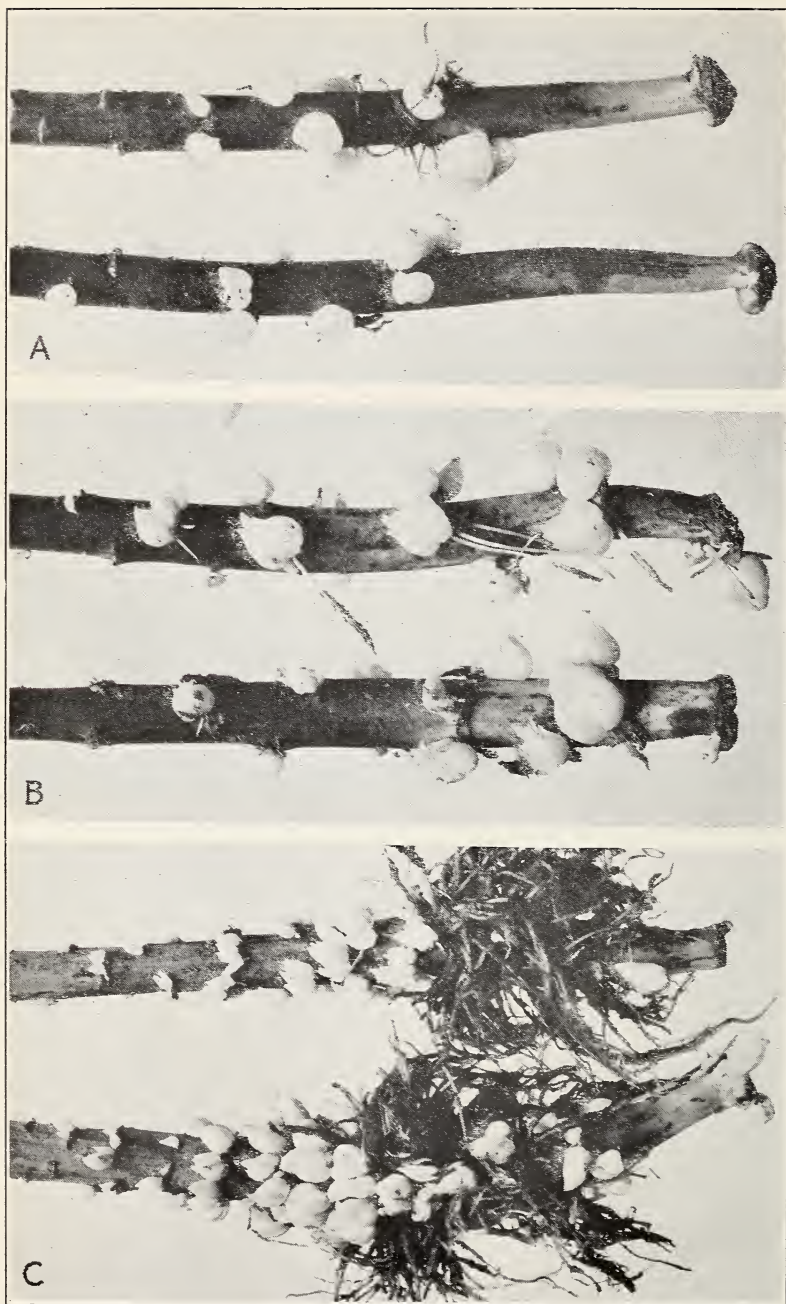




# PROPAGATION OF LILIES

- A.—Method of planting propagated stem bases of the Nankeen lily
- B.—One year's growth from scales of the Nankeen lily. The soil is washed off of a single row across a 3-foot bed, exposing the bulbs in place as they grew
- C.—A culture of the Madonna lily exactly comparable to B





## STEM PROPAGATION OF LILIES

- A.—Nankeen lily stems propagated for 35 days in dry sand under benches of an unheated greenhouse at Bellingham, Wash., in July–August, 1926. Note the large calluses, which are unusual
- B.—Madonna lily stems handled like those shown in A
- C.—Propagation of stems of *Lilium umbellatum* heeled in field July 5 to August 8



**TWO LILIES ON PUGET SOUND**

A.—A commercial planting of the Easter lily

B.—Seed production in the Regal lily on Vashon Island, Wash.





### REPRODUCTION OF THE TIGER LILY

A.—Development from scales between July and April

B.—A plant of the robust type showing the wealth of bulblets on the stems, in this case over 70, some of which measure 4 inches in circumference



## THE EASTER LILY

*(Lilium longiflorum)*

The commercial Easter lily is quite a variable plant and is obtainable in several horticultural forms. The varieties *Formosum* and *Giganteum* are imported from Japan, *Harrisii* from Bermuda, and *Erabu* from the Azores, and so on. In the last few years a number of recently named and selected seedlings have been placed on the market.

*Formosum* is exceedingly variable, as is also often what passes as *Harrisii*, indicating unselected seedling origin. A batch of a few thousand seedlings grown from seed of any of these varieties will usually duplicate nearly if not all of the standard horticultural forms.

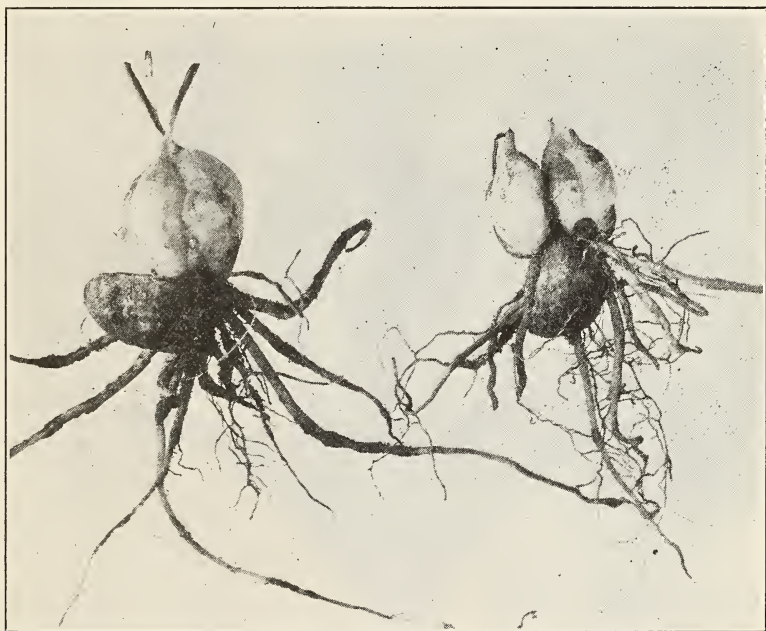


FIG. 6.—Reproduction of the Nankeen lily from scales. There is shown one year's growth, one bulb in one case and two in the other

Consequently the grower who wishes to go back to the virility of seedling stocks can do so readily by producing and growing a crop of seed, selecting his own strains, and using the general progeny to good advantage in the meantime for cut flowers; for all of them will produce marketable flowers, mostly of superior quality.

The production of the lily from seed is attended with but little difficulty, for the species is a profuse seeder. (Fig. 7.) The seed may be sown inside about November 1, pricked off into 2-inch pots or other flats about January, set in the field 6 inches apart each way in April, repotted from the field in October, and flowered during the winter. Some of the plants will flower in the field during the summer, when only 7 to 8 months old. The progeny thus produced can be used subsequently for vegetative propagation, the selections taking place in the greenhouse. (Pl. 3, A.) In order to obtain

complete uniformity, stocks are preferably worked up from single seedlings.

If the region is not too cold, the seedlings may be carried over winter in vegetative condition outside with a good mulch which is well aerated around the plants.

The seed may also be sown in frames in the spring, dug, reset deeper, and spaced in fall; or it may be left in the seed bed two seasons, thus giving good-sized bulbs to handle, although a large part of them may not have blossomed.

To produce a uniform product in a horticultural variety it is of course necessary to resort to vegetative reproduction, a form of which



FIG. 7.—A satisfactory seed crop on the Easter lily

occurs naturally in this lily. During the season's growth 4 to 10 or more bulblets are produced on the stem, mostly in the upper 2 inches of soil. (Fig. 8.) These are taken off at digging time and grown up for one to three years, when they are fit for the market. If digging is done early, the bulbs may be cut off and the stems heeled in in the field to allow the bulblets another month or six weeks to develop, during which time they may double in size.

In cases where it is desired to run up stocks, the lily in any of its forms may be propagated rapidly from scales by precisely the same methods as described under the Madonna lily. The stems may be layered, and bulblets will be produced in the axils of many if not all of the leaves. Or the stems may be made into cuttings of two

or more leaves each and planted in sand in the ordinary way, when bulblets will be formed in the axils of the leaves, but the stems will not make root.

In the region represented by Washington, D. C., this lily, if planted during the last half of October, seems to be perfectly hardy, especially if the progeny is from seed. It must not be planted too early, however, else top growth will occur in the fall, which will necessitate careful mulching. In six or seven years no losses have been experienced with plantings 4 inches deep. In a colder climate a 2-inch deeper planting may be imperative, and even a mulch may be advisable. On Puget Sound, from Bandon, Oreg., north, the lily often goes through the winter with no permanent injury, even when the plants have made considerable growth aboveground by Christmas.

It is difficult to give concise directions for handling this lily, for its habits differ to a remarkable degree in different climates. In the Gulf States the tops are dormant and dead in July, but in the climate of Washington, D. C., and northward the lily is all but an evergreen, and must be dug while the tops are still green, whether this takes place in mid-September for the market or in late October for resetting.

In digging bulbs for the market it has been the custom of growers in the North to watch for the formation of new roots, which appear as the summer temperatures begin to subside, about the middle of September. In the South, of course, the digging will take place during dormancy.

THE REGAL LILY  
(*Lilium regale*)

Although of comparatively recent introduction, the Regal lily promises to become one of the most useful as it is one of the most beautiful of lilies. Its home is north-central China, which assures its being hardy over a large part of the United States, where it has already been successfully wintered for a number of years. In New England and some other northern locations some losses have occurred, and on certain soils,

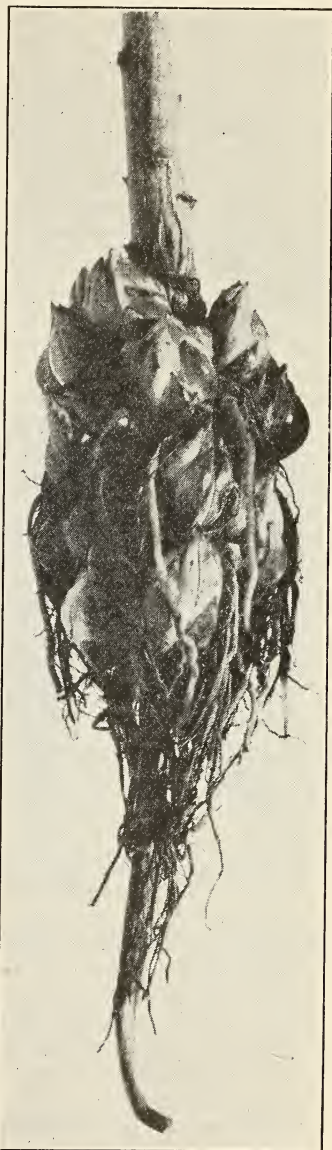


FIG. 8.—Vegetative reproduction in the form of stem bulblets naturally produced in *Lilium longiflorum*



even in northern New Jersey, this lily has received winter injury. On Puget Sound no injury is known on well-drained soil, except from the late spring freezes, which rarely occur after the stems are 6 or more inches high. While the lily may be denominated hardy, its foliage and stems are sensitive to even  $2^{\circ}$  to  $4^{\circ}$  of frost, and such frosts will probably be found to be the limiting factor in its culture.

The species must therefore be looked upon as not entirely hardy, and consequently more safely grown in our median latitudes, although with care and attention it is quite successful in the North where spring is not in the habit of lapsing back into winter. Attempts at its culture are being made in Florida, but it is too early yet to make definite pronouncements regarding success there. Tennessee, Kentucky, and the Carolinas are well adapted to its culture, and successes are the rule in

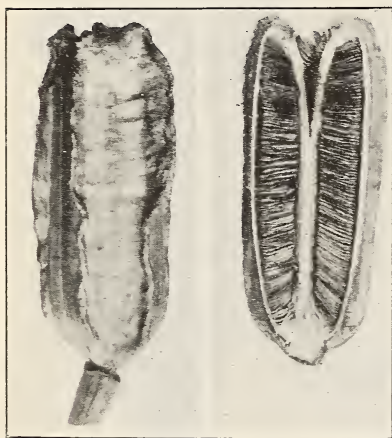


FIG. 9.—Pods of the Regal lily, showing the general character (left) and the large yield of seeds in place (right)

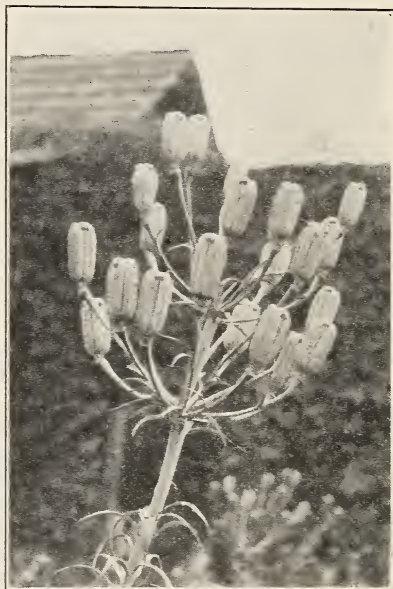


FIG. 10.—A prolific plant of the Regal lily on Puget Sound. There are 22 pods yielding about 10,000 seeds

Michigan, Ohio, New York, Massachusetts, California, Oregon, and Washington.

One method of reproduction is so preeminently superior to all others that it is really the only one that need be considered seriously at present. This is the method by seed. The lily is an abundant seeder, and the seed comes up readily and reaches full maturity in three years' growth, although usually under good culture abundant blossom occurs the second season, and a good proportion of the bulbs reach 6 to 7 inches in circumference. (Pl. 3, B, and figs. 9 and 10.)

To produce a good crop of seed, hand pollination seems to be necessary, although some seed sets without it. Pollinating should be done each morning through the flowering season, probably between 8 and 10 o'clock in most situations. The exact time will vary with the locality and the temperature from day to day. It should take place when the stigma is viscid and the anthers are dehiscing and shedding their pollen.



Seed of this lily is sown preferably in early spring, about six or more seeds to the inch in rows 6 inches apart and from one-fourth to 1 inch deep, depending upon the care which the grower intends to bestow on the planting to keep up suitable moisture conditions. If planting is done in frames, one-fourth to one-half inch is deep enough, and 3 inches may be space enough between the rows. If field planting is resorted to, a good seed bed is imperative and the seed should be planted 1 inch deep. A convenient seed bed is one in which there are six 6-inch rows running lengthwise, with two rows omitted for paths between the beds. In such a planting the seed can be put in with a garden drill.

If quick results are desired, the seed can be sown inside about November 1, pricked off in second leaf, and set outside in April, 6 inches apart each way. All plants thus handled should blossom the second year, and the bulbs should reach a circumference of 6 to 9 inches the third year without further transplanting.

Bulblets sometimes form on the stems underground, but the endeavor should be to grow this lily so perfectly that this will not occur. If digging is done early enough, which is likely from Washington, D. C., south, the bulbs can be cut off and the stems heeled in, to develop bulblets. Such bulblets, however, do not seem to mature much sooner than seedlings. The mature bulbs may also be scaled, and the scales will give rise to bulblets when handled as advised for the Madonna lily; but this method again seems to bring mature bulbs but little sooner than seed. (Fig. 11.) However, should the time come when horticultural varieties of insufficient merit appear, such methods of propagation will have to be resorted to in order to preserve and increase them. One such variety we have now in the Sargale, which is a Canadian hybrid between the Regal (which it resembles) and the Sargent lily.



FIG. 11.—Propagation of the Regal lily from scales in dry sand between March 15 and May 20. The scales were from bulbs which had failed because of basal rot

#### THE UMBELLATUM LILY (*Lilium umbellatum*<sup>1</sup>)

The Umbellatum group of lilies is a heterogeneous assemblage, mostly of easy culture but uncertain identification.

<sup>1</sup> No effort is made to straighten out the nomenclature of this and *Lilium elegans*. All that is attempted is to conform to commercial usage in the application of names. Unfortunately even this is not at all easy to do, for there does not seem to be any uniformity of practice. During the past two seasons the writer has received this variety under six names from reputable English and Dutch firms. It is his judgment that it is closely related to and may be derived from *Lilium bulbiferum*. However, it is seldom that bulblets are formed naturally in the axils of the leaves, although it is easy to induce them to form by increased fertility, suitable moisture supply, banking, or removal of flower buds before anthesis.

The variety experimented with seems to be one of the best. It is commonly seen in private gardens in the Pacific Northwest, whence the writer's stock was secured.

Like all lilies which are capable of large use, this one is easily produced. There are two main methods for increasing one's stock of it, and there is very little choice between them.

The bulbs (fig. 12) for propagation may be dug as the flowers fade. The stems can be cut off flush with the top of the bulb or twisted slightly and jerked out before digging, as one chooses. The scales are then broken off without bruising. If the grower is cautious and inexperienced, only about two layers of scales will be removed, but experience may beget venturesomeness and he is likely to remove them down to the crown for next year's performance.

The scales are then handled in precisely the same manner as described for the Madonna lily. From these scales, bulbs will be produced the next season which will throw basal leaves mainly; many of



FIG. 12.—Double, single, and triple nosed bulbs of *Lilium umbellatum*. They measure 8 to 11 inches in circumference

them, however, will send up stems 3 to 8 inches high, but no flowers will be produced until the second year, and then not many.

The second method of propagation is also very similar to that of the Madonna lily. If the bulbs are not to be dug, the stems can be jerked out of the ground shortly after the flowers have faded, without disturbing the bulbs at all, and immediately heeled in in the field with 12 to 15 inches of their bases covered with soil. The production of bulblets in the axils of the leaves thus covered is phenomenal. A reproduction of 30 to 50 bulblets may be expected from mature normal stems by the first of September. (See pl. 2, C, and pl. 5.)

When the stems with attached propagation are taken out of the heeling ground the latter part of September, the exposed tops can be cut off and the bases with bulblets intact planted, preferably in beds excavated 2½ to 3 inches deep. A very good plan is to lay the stem bases end to end across the bed. The writer has had good results in this kind of a propagation between early July and the end of August. The next season many stems 6 to 12 inches high will be produced, and many of these will bear bulblets just below the surface of the ground.

Since it takes salable bulbs to propagate by the scale method, and since the stem method entails no destruction of merchantable material, it would seem that the latter is to be preferred. This method, together with the natural splitting of the bulbs themselves and the production of stem bulblets in the young plants, should give ample material for the maintenance and increase of stock.

Both scales and stems may be incubated as described for the Madonna lily.

Thus far, this lily has been used for garden decoration only, but it has been shown that it can be forced nicely for early spring flowering if brought into heat about the first of the year. There is one record of its making an appeal on the American market as a cut flower.

#### THE ORANGE LILY

(*Lilium croceum*)

The Orange lily, so prominent in cottage gardens in portions of the British Isles, has seldom been seen in the United States until the last few years. It is one of the best and most easily grown of the upright flowered group of lilies. It is reproduced like *Lilium umbellatum*, from scales and layered stems, although not quite so abundantly from stem bulblets. It also seeds quite readily, but there has been no experience yet in growing the seed.

#### THE THUNBERG LILY

(*Lilium elegans*)

The stocks of the Thunberg group experimented with most have been of Japanese origin and included Atrosanguineum, Orange, Pleno, and Incomparable. Contrary to usual experience, they have not proved to be strong growers but are large flowered and dwarf.

They appear to be more or less self-sterile. One satisfactory set of seed has been obtained, however, by using pollen of *Lilium longiflorum*. Reproduction is effected by scales and by bulblets, which are rather freely produced, especially in young plants, on the underground portions of the stems. The scales, although much less numerous, are handled like those of *L. umbellatum*.

#### THE REDSTAR LILY

(*Lilium concolor*)

The Redstar lily, like its counterpart in the *Lilium tenuifolium* group, while not so striking as the larger species, is handsome, floriferous, and a good bedding lily of very easy culture. It produces an abundance of seed when properly handled. This germinates in the spring, when sown at the end of August on Puget Sound, and produces an abundance of blossom the second year even when grown thick, 100 or more bulbs to a 3-foot row. Seeding is the only satisfactory method of reproduction tried, and no other is necessary. To produce a good crop of seed, however, at Bellingham, Wash., artificial watering is necessary and hand pollination is advisable.



## THE TIGER LILY

*(Lilium tigrinum)*

The Tiger is a very common and excellent garden lily, easy to grow, rapid of reproduction, and adapted to a great variety of conditions. Its wide use attests its popularity.

There are several distinct forms, but the best is the type which is most common in gardens throughout the United States, especially in the East. There are now commonly imported from Japan *Lilium tigrinum fortunei*, *L. tigrinum splendens*, and *L. tigrinum flore-pleno*. There exists a very dwarf form, less than half the size of the common Tiger lily, which multiplies by the bulb most profusely and very probably may find a profitable niche in American gardens when stocks are made available.

Two accidental introductions from Japan show that a form of the type exists which is even more robust than the one commonly found in American gardens. The ones the writer has seen are lighter in color than the common Tiger lily, and often become 7 to 9 feet high. When well grown, this lily sometimes gives stem bulblets 4 inches in circumference. (Pl. 4, B.) These blossom the first year from September planting.

The Tiger lily in all its forms is very advantageously increased by means of bulbils so profusely produced in the axils of the leaves. (Pl. 7, B.) This, however, is by no means the only or even perchance the best method. In three or four trial cases better comparative results by far have been obtained with scale propagation than with bulbils. (Pl. 4, A.) This fact will be very useful to the grower in working up stocks from a small quantity of material, as will almost invariably have to be done with most lilies. The scales are handled as described under the Madonna lily.

The dwarf Tiger makes a much more rapid increase by the splitting up of the bulb than do any of the other varieties. (Fig. 13.) It also produces plenty of bulbils.

If one is dealing with the typical Tiger lily of our gardens, propagation in the eastern United States will take place about the middle of July, and on Puget Sound three or four weeks later. The bulbils are removed from the plants and immediately planted 2 inches deep. If the bulbils are small, they can be strewn in about 35 to 50 to a 6-inch row across a 3-foot bed and reset the next season as soon as dormant. If they are large, it may be more advantageous to set them up about 11 to the row. They will then not need to be disturbed until dug for the market, whether this is at the end of the second or third growing season. Abundant blossom will occur the second year, and a great deal of propagation in the form of bulbils the first. Three-fourths of the plants should give one to five flowers the second year in the bulbil bed. (Pl. 7, B.)

## THE LEOPARD LILY

*(Lilium pardalinum)*

The Leopard lily is an inhabitant of moist stream banks of the Coast and Sierra Nevada Ranges of California and extends from a few feet above sea level to an altitude of about 5,000 feet. It is known locally as Tiger lily. Although very amenable to garden culture, where it often attains a height of 6 or 7 feet with a panicle of 20 to



30 flowers, in nature it grows mostly in rather moist or even boggy places. All the stock experimented with in the investigations discussed here was dug out of 4 inches of water in a marshy place on the edge of a mountain stream when the plants were in full blossom.

There are two main methods of propagating this lily, one by seed and the other by scales. (Pl. 8, A, *e.*) There is also a rather rapid increase by the bulb, one commonly giving rise to two at each season's growth. On Puget Sound the seed is most conveniently planted in beds in the open field where the rows can be 3 inches apart and 100 or more seeds sown three-fourths to 1 inch deep to the 3-foot row. (Fig. 14.) The seedlings can remain in the seed bed two years, then be dug, and spaced in resetting. An occasional flower may be seen in the seed bed the second year if the plants are exceptionally well grown under field conditions. There is an abundance of blossom the third year, and full flowering the fourth.

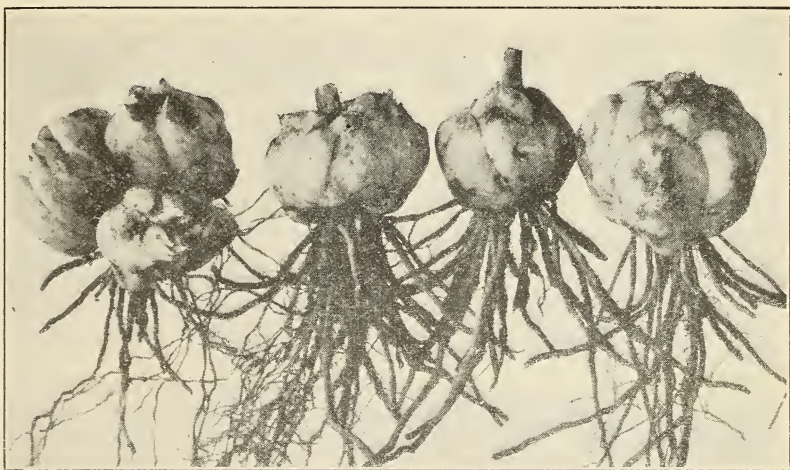


FIG. 13.—Tiger lily bulbs. From left to right are dwarf, Fortunei, ordinary type, and robust type. The first consists of three 5-nosed bulbs

The scales of the bulb of the Leopard lily are mostly jointed and exceedingly variable in size. The joints may be one-half inch in length and three-eighths of an inch wide, or little larger than a grain of wheat. They vary in color from pure white to yellowish, are very fragile, and easily broken off in handling. In practically all plantings, plenty of small bulbs are found around the parent, which have developed from scales unavoidably broken off in handling. In the containers in which the bulbs are brought from the field, an abundance of scales will always be found, all of which may be used for propagation. These are usually the terminal joints, the basal ones commonly remaining attached to the older part of the short rhizome or bulb. (Fig. 15.)

The scales or scale sections are very easily handled for increasing stock. The writer's favorite method is to drill them in, in 3 to 6 inch rows and about 100 to the row, in beds in the field similar to those described for the seed, except that the scales are put down a little deeper. The development from scales is but little more rapid

than that from seed. More blossoms are commonly seen the second year from scale propagation, however, as there are nearly always some scales included which have bulblets attached when planted.

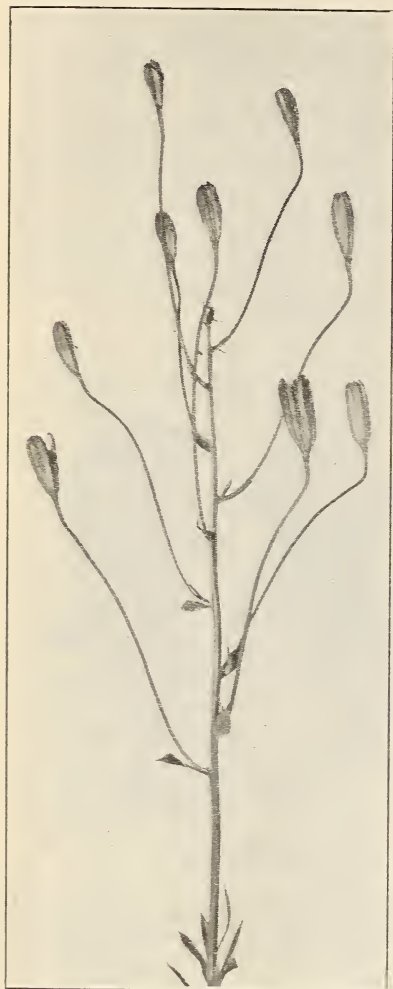


FIG. 14.—Seed production in the Leopard lily

#### THE LEMON LILY

(*Lilium parryi*)

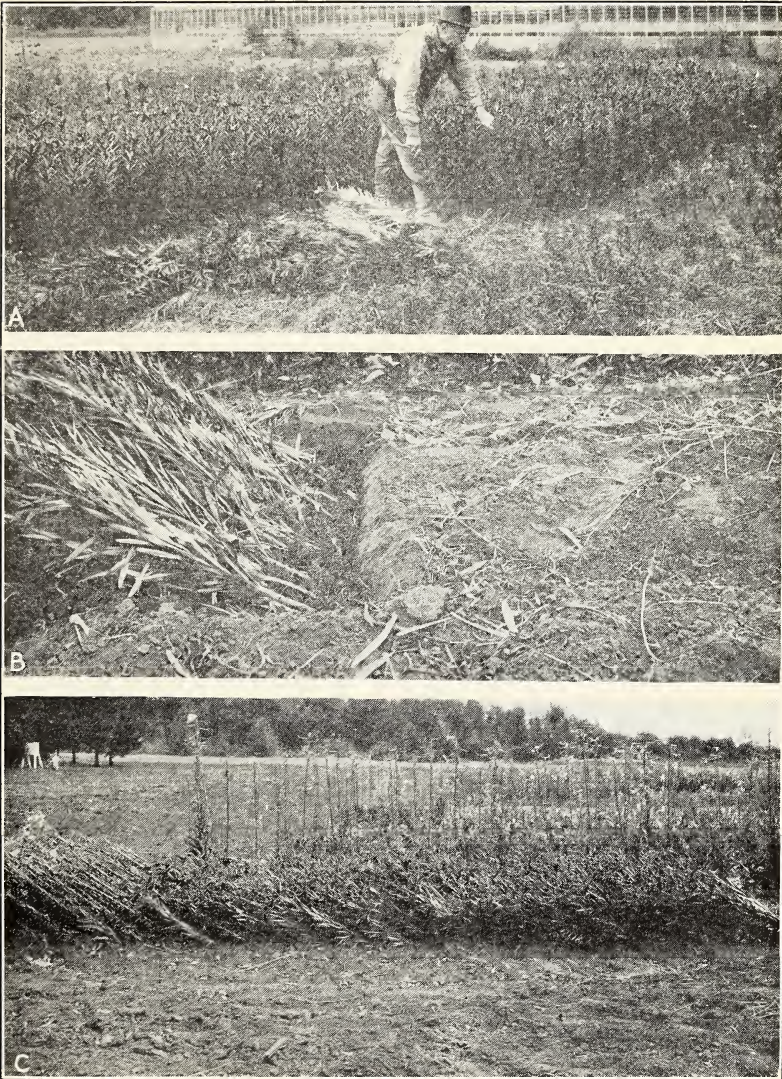
The Lemon lily, like the Leopard, is an inhabitant of moist situations in meadows and along streams, mainly in the San Bernardino Mountains of southern California. It is also very amenable to culture and adapts itself readily to loamy soil under good garden or field culture.

This is the only clear, clean, yellow-flowered lily in the country. Since it is both handsome and of easy culture, it becomes of very great importance in itself and of potential value for breeding purposes. The species is variable, there being two very distinct forms of it. Indeed, they are so distinct even in their vegetative condition that the writer has often been almost convinced in the spring, when the plants are 1 to 2 feet high, that the stocks have been mixed. One form is strict and tall, with narrow leaves, smaller, narrower, less campanulate flowers, inclined to bear a few minute dark-brown spots in their throats. The other form is not so tall, has broader leaves, larger, more spreading flowers of a clearer, slightly deeper yellow, more nearly and often entirely devoid of the small dark-brown spots in the throat. The latter is by far the better form.

The propagation (pl. 8, A, *d*) of the Lemon lily is exactly the same as that of the Leopard lily and as easily done, except that the seed should be planted as soon as gathered; otherwise, if allowed to dry until spring, it lies in the ground a year before it comes up. It is a good seeder. (Fig. 16.) The seed matures perfectly the last of August on Puget Sound and germinates in the spring from fall sowing.

Most of the bulbs of this lily on the market have been dug from the wild and distributed by but few collectors. It is getting scarce, however, and consequently must be cultivated if it is to be enjoyed much longer. This, fortunately, is an easy thing to do. It is espe-





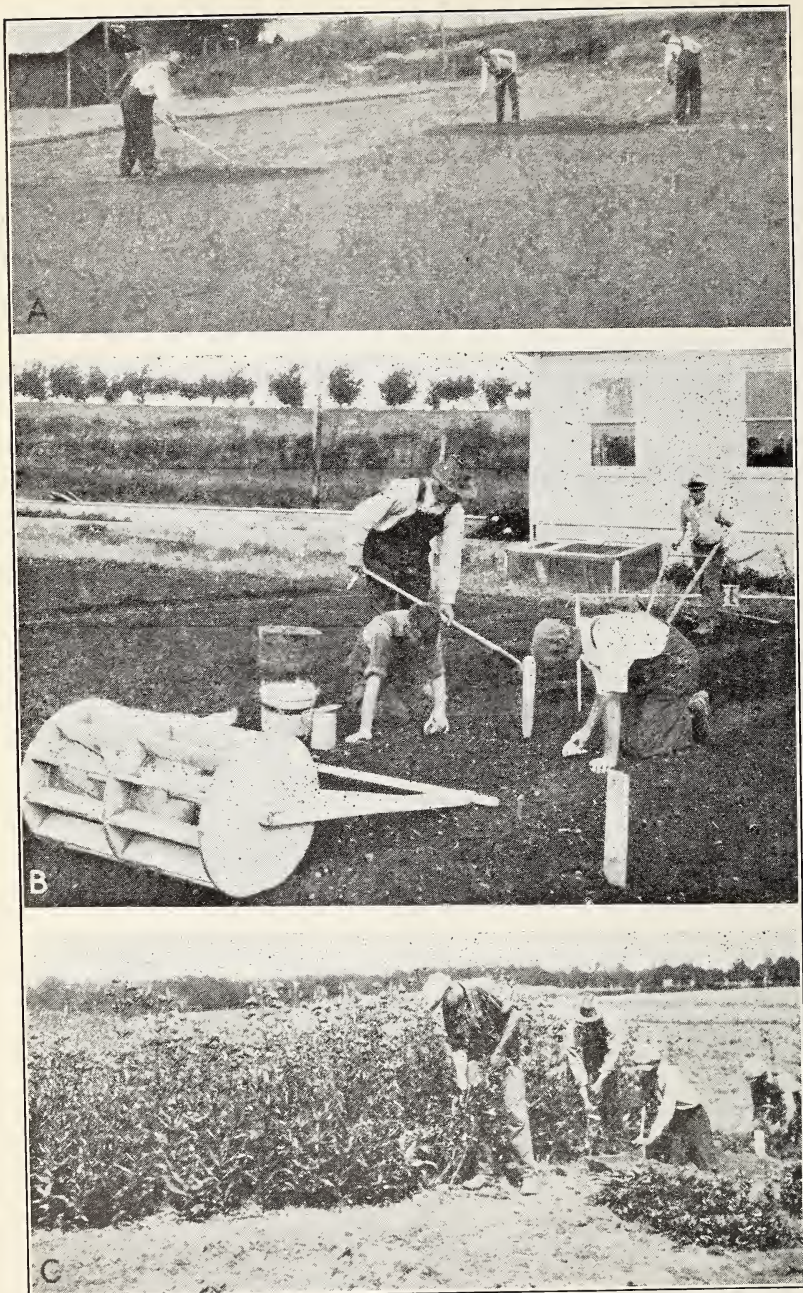
PROPAGATION OF *LILIUM UMBELLATUM*

A.—Jerking the stems out of the bulbs at the close of flowering

B.—Method of heeling in the stems

C.—A bed 3 feet wide and 30 feet long, with stems heeled in for propagation. There are shown 1,000 counted stems, mainly of *Lilium umbellatum*, which yielded more than 30,000 propagations in about 40 days. (See pl. 2, C)

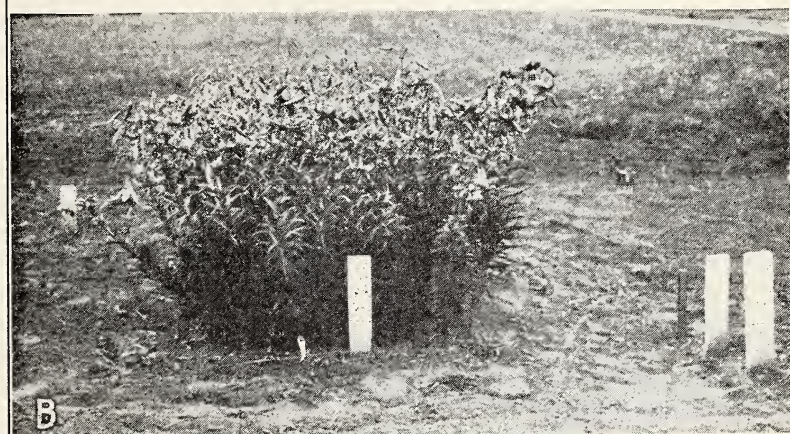




#### OPERATIONS IN LILY CULTURE

- A.—Preparing the seed bed with hand rakes to smooth, fine, and level the soil and rid it of gravel and other debris which might interfere with planting and germination
- B.—Planting the seed
- C.—Digging *Lilium humboldti magnificum* for propagation. Note that the plants are in full blossom, a little too early but still effective





#### PROPAGATION OF LILIES

- A.—Digging lilies for propagation as soon as the flowers have faded  
B.—Typical form of *Lilium tigrinum* the second year from bulbils  
C.—*Lilium speciosum rubrum*, from scales planted in the field in early August, 1925; photographed in late April, 1926





GROWTH OF LILIES FROM SCALES BETWEEN JULY AND APRIL AT BELLINGHAM, WASH.

- A.—a, *Lilium washingtonianum*; b, *L. humboldti magnificum*; c, *L. humboldti*; d, *L. parryi*; e, *L. pardalinum*  
 B.—Field view of Madonna and Nankeen scale plantings. The beds, 60 feet long, each contain more than 10,000 propagations. Hand weeding is economically practicable in such a planting



cially well adapted to be cultivated on the north Pacific coast, where seed can be matured very well. At Bellingham, Wash., it has been grown successfully for the last eight years on both Whatcom silt and Lynden gravelly loam. Its worst enemies are the Chinese and Hungarian pheasants, which are very fond of lily bulbs, especially in the seedling stage, and destroy them very rapidly.

#### THE HUMBOLDT LILY

(*Lilium humboldti*)

Of the West coast lilies, all things considered, the Humboldt group contains the most superb. Many forms can be recognized in any



FIG. 15.—A clump of *Lilium pardalinum* bulbs grown in two years from one mature bulb. There are seven or eight growing points which will produce stems next season

planting, but what is commonly sold as *Lilium humboldti magnificum* is the best as well as the most variable. It is far superior to the type or the Bloomerianum variety. The Magnificum variety is very large, handsome, robust, floriferous, and easy of culture and reproduction. The writer must confess a very large measure of ignorance regarding its distribution. It is usually recorded for the Coast Mountains from Santa Barbara south, but it also occurs on the Sacramento River bottom in Butte County and in the foothills and mountains up to an altitude of 1,500 to 2,000 feet, where the species *L. humboldti* also occurs.

It is a remarkably variable form in almost every detail. In the experimental planting at Bellingham, Wash., consisting of close to 2,000 bulbs grown mainly from seed, it is difficult to find two plants upon which the flowers are alike. The vegetative portions of the plants are nearly as variable, and the bulbs scarcely seem to belong to the same species. There are all degrees of development of stem roots, as illustrated in Figures 17 and 18.

It is a lily for the masses, for home and garden decoration, and adapted to a wide range of conditions. It has done well at Washington, D. C.; it grows to perfection at Bellingham, Wash., and makes beautiful clumps in gardens with irrigation—where it is desirable to dig and reset about every third year—on the valley floor of the Sacramento Valley, where the summer temperature often reaches 115° F.

The reproduction is effected by seed and by scales. The latter method with the Humboldt lily is about as satisfactory as with any lily known. (Pl. 8, A, *b* and *c*.) The writer's experience with it has been mainly on Puget Sound, where its handling has been successful on both Whatcom silt and Lynden gravelly loam.

The stocks have usually been dug as soon as the flowers have faded, and never later than the middle of August. The bulbs have been scaled and both bulbs and scales planted a few days after digging. The scales are planted 2 inches deep, 2 or 3 to the inch in rows 6 inches apart, where they remain preferably for two years. Stems 6 to 10 inches high are produced the first year, and the bulbs reach 2¼ to 3 inches in circumference. The second year a few blossoms may be seen. It is not at all uncommon to have three or even four bulbs form on one scale, one from each joint. It is believed that scaling the bulbs should be done but once in two years and that transplanting of general commercial stocks need not take place more often, but



FIG. 16.—Seed production in the Lemon lily

good growth of both bulbs and scales has been had when lifting and scaling were done in two successive years, although the vigor of the old plants was reduced.

This lily is a good seed producer. While hand pollination has seemed advantageous, a good supply of seed is usually produced without it. The species matures readily even in the short season at Bellingham, Wash. It has been the practice at Bellingham to plant the seed in the fall. It comes up in the spring. In one instance a few flowers appeared the second year, a large percentage the third year in the seed bed, and full development of both plants and bulbs the fourth year. This means that this, like most lilies, can be marketed after the third year's growth.



## THE TURK'S-CAP LILY

*(Lilium superbum)*

The eastern Turk's-cap lowland lily, so familiar throughout the eastern United States, needs neither introduction nor description. It is a beautiful lily and, like the western forms of this group, is easily reproduced from both seed and scales. When well grown, it will often give an annual doubling by bulb reproduction also, as illustrated in Figure 1. The latter method furnishes sufficient stock for the householder, but is of little value to the commercial grower.

The seed matures in the eastern United States about the middle of October in the higher valleys and two weeks earlier on the lowlands. It should be planted before it is thoroughly dried out, else it will lie in the soil a whole year before it germinates. If planted as soon as gathered, it comes up the following spring. If thoroughly dried, it comes up the second spring, but with no apparent reduction in vigor.

As would be expected of a plant of such wide distribution, it is exceedingly variable not only in its morphological characters but in its reactions to cultural conditions as well. On Puget Sound the form from the vicinity of Washington, D. C., flowers too late to mature seed naturally, and no attempt has been made to bring the stems inside upon the advent of cold weather.

The culture from scales does not differ essentially from that described for the Leopard lily. The eastern Turk's-cap, however, blossoms so late that the soil is likely to be cold and wet at planting time. It seems that the scales of this species do not suffer from

such adverse soil conditions as much as those of the Madonna and others, for good success has been the rule at Bellingham, Wash., from scale plantings made the last of August. Good growth was obtained one year from plantings made the last of July, about a month before the regular time of blossoming.

Whenever there is danger from too late planting of the scales, they can be propagated artificially in dry sand under cover, as described for the Madonna lily. It is well, however, with this and all other small-scaled species, to screen the sand or soil rather carefully through a mesh fine enough to hold the shrunken scales when they are removed from the propagating bed in the spring preparatory to lining out in the field.

## THE COLUMBIA LILY

*(Lilium columbianum)*

The Columbia lily is a species of wide and varied distribution. On Puget Sound it is distributed from slightly above sea level to an

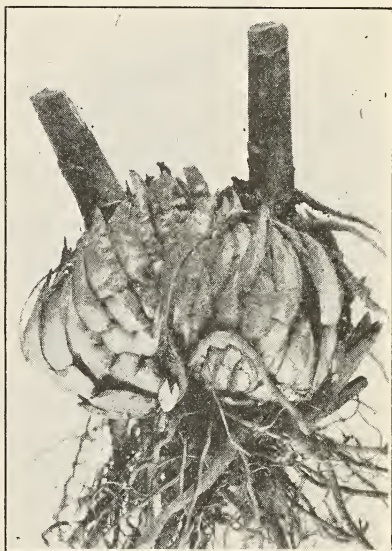


FIG. 17.—*Lilium humboldti magnificum* bulb, showing jointed scales and paucity of stem roots. It is five years from seed



altitude of 2,500 feet, across the mountains, through the "inland empire," and southward into northwestern California.

Like the Turk's-cap lily, it multiplies best from scales and seeds in exactly the same way as described for that species. It is an abundant seeder throughout its range. At Bellingham, Wash., both in nature and under cultivation, without artificial pollination, practically every blossom produces a seed pod filled with 300 or more viable seeds.

In 1918 a large quantity of seed of this species was collected locally near Bellingham. One-eighth of an acre was planted in rows 12 inches apart. The seed was put in with a garden drill 1 to 1½

inches deep in late August, after such a preparation of soil as is advised elsewhere in this bulletin (p. 5.) Germination took place in the spring, and there was a perfect stand over the entire area, netting about 125,000 seedlings, a portion of which were grown to maturity in three years.

Reproduction from scales, while just as certain, seems rather slower than with the other members of the western Turk's-cap group, as it has taken about four years to get blossoming bulbs in the trials which have been made at Bellingham.

Since blossoming takes place early in the season, the lily can be dug early

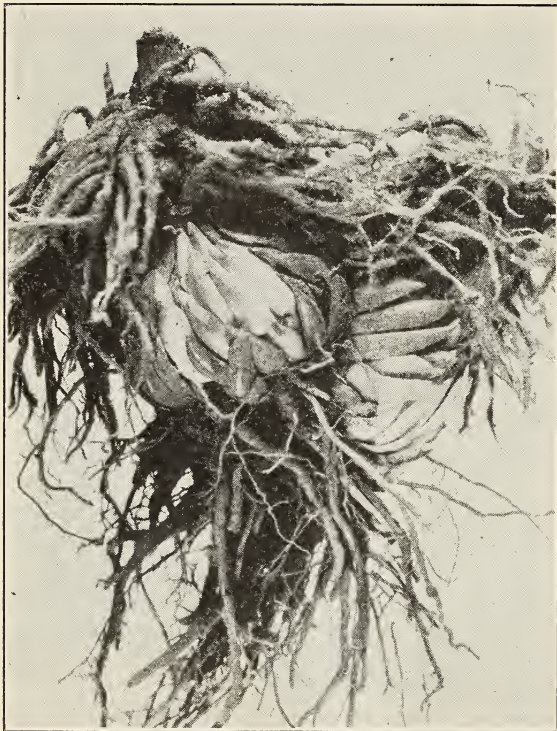


FIG. 18.—*Lilium humboldti magnificum*, showing wonderful development of stem roots; also five years from seed. Compare Figure 17

enough so that the scales can be planted in the open with safety at Bellingham.

It is common on Puget Sound to find more or less scale propagation on this lily when it is dug from the wild. In digging 150 bulbs in the vicinity of the garden at Bellingham, Wash., one year in late August, several were found which had the basal plate eaten off, probably by mice, but all the scales were producing bulblets.

All lily bulbs should be handled carefully and not allowed to dry. The bulbs of the Columbia lily are more sensitive to desiccation than those of any other species discussed here. They go bad very quickly with a dry rot. The writer has not been able to get the bulbs from

the Pacific coast to Washington, D. C., by mail, which takes less than a week, in good condition without surrounding the wrapped bulbs with moist moss.

#### THE CANADA LILY

(*Lilium canadense*)

The native Canada lily adapts itself to cultivation admirably under either garden or field conditions. It can usually be procured from collectors in either yellow or red forms, the former, so far as the writer's experience goes, being more robust.

This species is to be looked upon as one to be reproduced like the Leopard and eastern Turk's-cap from scales and seed. At Bellingham, Wash., although it blossoms rather late, seed production is possible, but up to this time no experience with seed handling has been developed. Culture from scales presents no serious difficulties. Indeed, the scales of this lily develop as readily as those of the Leopard or eastern Turk's-cap when handled in the same way. In the two trials made at Bellingham, scales planted as described were set in the field the last of August. This is rather late, and some anxiety was felt lest they should rot, but good propagation resulted.

#### THE CORAL LILY

(*Lilium tenuifolium*)

The Coral or Siberian lily is a dwarf, 12 to 24 inches high, and as hardy as its name would indicate. It is one of the best of the dwarf kinds, well adapted to garden decoration, and when carefully grown from sized bulbs it makes as good a bedder as a tulip. It is said to be a short-lived species, disappearing at about 5 years of age. The writer's experience on this point is not conclusive. A few bulbs are now at Bellingham, Wash., from seed sown in the fall of 1919 under field conditions in that location. They were reset in August, 1927, and seemed to be in perfect condition.

There is a desirable yellow form, with which no experience has been had.

There is but one good way to reproduce this lily, and that is from seed, which is produced liberally and matures in the open both in the District of Columbia and at Bellingham, Wash. Being a dwarf and a small, fine-leaved species, it can be grown very thick. The writer prefers to plant the seed 150 or more in each of the 3-foot rows, which may be only 3 or 4 inches apart. The seedlings are left in the field seed bed two seasons. If the seedlings are well grown, there will be an abundance of flowers the second season, and 25 per cent or more of the bulbs will be merchantable. A good stand of plants from such a thick planting always creates surprise when the crop is dug from the seed bed. The bulbs come out of the ground in ribbons and are beautiful in appearance.

Small stocks of the Coral lily have been produced in this country for many years, but never enough to supply the demand at high prices, even when supplemented by occasional importations from abroad, mainly from Japanese sources. Both the stocks and the importations have dwindled in recent years, so that the lily is now difficult to obtain.



## THE MARTAGON LILY

*(Lilium martagon)*

The Martagon lily consists of a group of horticultural varieties. There exist a dull purplish form which is the type, a white form, and a bright purple one which is the Dalmaticum variety. Like the Regal and so many other lilies, the stature of the species varies a great deal. Under field conditions at Bellingham, Wash., the plants the first year after transplanting seldom grow over 24 inches high, but old, established clumps in borders are said to become 5 to 7 feet high. Little seems to be lost in bulb growth, however, by the small plants.

The lily is readily reproduced by either scales or seed. Of the three varieties mentioned above, the Dalmaticum has been grown in Washington, D. C., and the type and white forms at Bellingham, Wash. About three weeks after the flowers faded the plants were dug, the bulbs scaled, and both bulbs and scales planted in the field in precisely the same way as described for the Madonna lily. Seed production takes place without hand pollination at Bellingham, and this lily has come up in the spring from September sowing when handled as advised on page 31. The writer considers reproduction from seed to be the most satisfactory method.

## THE HANSON LILY

*(Lilium hansonii)*

The writer has some hesitation in including the Hanson lily in a list of 20 easy propagators, for its handling thus far has not fully met expectations, and it is thought that more concentrated attention and experience may reveal more advantageous methods or modifications of the methods of increasing its stock. It has grown well and blossomed profusely for two years on the Arlington farm, and vegetative growth has been perfectly satisfactory at Bellingham, but without blossom. It is believed that not a single bulb has been lost, but only the first year, following very late planting, has the species produced satisfactory flowers.

The trouble is that the lily is unusually sensitive to late frosts, which for the last three or four years have killed the terminal portion of the stem but have not caused so much injury, but that 3 feet of healthy, vigorous, normal stem functions during the entire season. This condition seems to hold generally for the species in the Puget Sound region. It is very prone to injury wherever frosty conditions obtain late in the spring.

No seed has been produced in either location, and no special effort has been made to induce seed production. The Hanson lily is an early bloomer and consequently may be dug for propagation about the middle of July on Puget Sound. This is early enough to permit lining out the scales in the field during the dry midsummer season for callusing and starting growth.

Scale propagation made in July, as described for the Madonna lily, has vegetated in the spring with a satisfactory stand. It seems to be desirable with this lily, however, to use care not to get the scales too deep—not over 2 inches, and better still 1 to 1½ inches. This makes imperative a winter mulch of debris, which is to be removed in the spring to allow the plants to come up. Like so many



lilies, it propagates very satisfactorily at the close of the blossoming period.

#### THE HENRY LILY

(*Lilium henryi*)

*Lilium henryi*, a very satisfactory Japanese lily, is usually referred to in commerce as the yellow Speciosum, and this name, although connecting it with a botanical species to which it does not belong, is more suggestive of relationships than the Henry lily, which is derived from the botanical name and is the name commonly used in the books. In texture and outline of the flower it resembles very closely the Speciosum group, but the color is yellow-orange and the general appearance of the plants is very different.

There are several ways in which this lily may be propagated, as with the Madonna; but with the Henry lily, as with the Regal, the grower will probably in most cases rely almost, if not entirely, on propagation by seed, especially in commercial production.

This lily is a prolific seeder but must be pollinated for good crops and should have a long season for maturation. It is only with difficulty that seed can be matured on Puget Sound, as it is always necessary to cut the stems while the seed is still green and finish the maturity in a warm, light, and preferably airy situation in vases of water under cover. This method is necessary in some seasons, even in the climate of the District of Columbia. This necessity is a little troublesome, but it accomplishes the purpose and makes it possible to produce good crops of seed. The requirement, after all, is not unduly burdensome, for a good plant will carry five or more seed pods holding 50 to 500 seeds each.

The seed can be handled in precisely the same manner as advised for the Regal lily, and the plants flower and the bulbs attain full size in about the same time as recorded for that species. If seed is started inside in November and the plants pricked off in January and put in the open 6 inches apart in April, practically every plant should blossom the second year, and no transplanting should be necessary or advisable until the bulbs are dug for the market.

Occasionally a few bulblets are formed on the stems underground. An abundance of them can be produced if the stems in flower are jerked out of the bulbs and heeled in in the field for six weeks or more, as described under the Regal lily. There is little object, however, in resorting to this form of reproduction, since the species comes so readily and true to type from seed. The species can also be readily propagated from scales, as previously described.

The bulbs of the yellow Speciosum are imported from Japan in considerable quantities each year. They arrive in the United States in early winter, are potted up for early summer flowering, planted out of doors, or put in storage until spring. Judging from experience with the Regal lily, it would be very desirable for some American growers to plant a few cases of imported bulbs and thus start supplying the market with seed.

The writer has experienced no winter injury with the Henry lily either on Puget Sound or the Arlington farm, but it has suffered from late spring frosts in both situations.

## THE SPECIOSUM LILY

*(Lilium speciosum)*

The Speciosum lily is also a group of related forms, sold under the varietal names Rubrum, Roseum, Album, Melpomene, Magnificum, Kraetzeri, etc. All of these varieties are imported from Japan in rather large quantities—as large as can be secured each fall, it is said—and a few from Europe. The bulbs arrive in December or January and are immediately potted up for forcing or placed in cold storage for later potting or for spring planting out of doors. From forcing they come into blossom in early summer, and under garden culture in late summer.

They constitute a beautiful and varied group of lilies capable of reproduction by three methods—scales, seeds, and stem bulblets. Like so many lilies, these seem to be suited for digging for vegetative propagation at the close of the blossoming season.



FIG. 19.—Scale propagation in *Lilium speciosum rubrum*. The scales were covered with dry sand under the benches of an unheated greenhouse in August and photographed the last of the following April on being removed to the field.

If the ground is likely to be more or less dry for the next three weeks after digging, the scales may be planted out of doors in precisely the same manner as described for the Madonna lily. (Pl. 7, C.) If, however, it is likely to be wet and cold, as is always the case on Puget Sound, the scales are best put in rather dry sand on a dirt floor under cover. (Fig. 19.) This is always the case with imported bulbs, on account of late arrival, and to a considerable degree also with domestic-grown bulbs, owing to the late flowering of the varieties.

The scales may remain in this propagating bed until early or even late spring and then be lined out where they are to remain for one or two years. There is no definite point to which the bulblets must be developed on the scales before they are planted. All that is necessary is to have the scales thoroughly callused and, preferably, starting to bud. They will then stand cold, wet ground much better, but not before the broken surface is thoroughly healed.

The grower should keep in mind that he is dealing with cuttings which must be callused before being subjected to the many vicissitudes of the open ground, and treat them exactly the same as he would hardwood cuttings, except that in this case the cutting is completely buried and remains so until all used up.

There has been some difficulty in producing seed of this lily and in growing it after it has been produced. The forms mature late, and it is therefore necessary to cut the stems before killing frosts

and to mature the seed in vessels of water in a living room or in a slightly lower temperature.

On Puget Sound the lily does not blossom until late August, which gives it only 30 days of lowering temperature for development of seed. This is not time enough, and consequently seed is not usually matured, although a few individual plants have succeeded. Even in the vicinity of Washington, D. C., it is usually necessary to finish maturation on the cut stems indoors.

As soon as mature and before it has thoroughly dried out, the seed should be planted; otherwise it will not come up until the second year. This characteristic of the *Speciosum* and some other lilies, particularly *Lilium auratum*, introduces a difficulty in ordinary commercial handling. It makes it imperative that the grower produce his own seed or that he secure it from near-by or from extraordinarily reliable sources. In several tests made with one crop of seed of these lilies, a prompt 80 per cent germination was obtained with seed held in storage until the second spring after maturity. This lead should be followed up. If it is found that this characteristic holds generally for this lily and for *L. auratum*, it may effect a decided economy in handling seed which has dried.

The *Speciosum* lilies also produce stem bulblets just at or under the surface of the ground. These should all be saved and planted. If these lilies are dug for propagation in blossom, the stems may be jerked out before digging and heeled in in the field to continue the growth of the bulblets already formed and to produce others. This propagation can be moved to its permanent quarters later in the fall or in early winter, or preferably in early spring.

#### PREPARING STOCKS FOR PLANTING

In commerce, all roots are trimmed from lily bulbs. It has not been the practice in these investigations to molest them except occasionally on the Arlington farm, where the practice has not been uniform. The writer believes that it does not make a great deal of difference one way or the other. It takes labor to trim the roots, but the setting is more easily done when they are cut. When resetting takes place immediately on digging, many of the roots become re-established. It is thought that there may be some advantage in leaving them uncut, but the difference is not great.

The sizing of lily bulbs has been done by hand. It would require a complicated machine to do the job mechanically without injury. In the work here outlined it has been the practice to sort the bulbs into two or at most three sizes, depending on the nature of the bulbs.

In the work of sizing, it is preferable to spread the bulbs out on a table and pick out one size and then another, leaving the balance on the table to go into a third class. This plan is found to be much more satisfactory than attempting to handle all the bulbs by making three sizes at one time.

#### MULCH

It is not thought that the use of a winter mulch is imperative in either the Puget Sound or the Virginia location when handling mature bulbs of any of the 20 lilies discussed in this circular. Mulching, however, has been resorted to frequently in the former location,



straw having been spread on for protection, and in the latter rough manure was applied mainly to add fertility. There is no question about the beneficial effect of a mulch, and it may be economically justifiable. On small stock planted shallow it is a necessity. Experience at present does not warrant positive or final pronouncements.

A summer mulch is exceedingly important in much of lily culture. Large stocks may be so spaced that the plants shade the ground, obviating to some extent the necessity for further protection, but small bulbs, scale propagation, and seedlings receive great benefit from even a slight covering of the soil.

On Puget Sound short straw and screened native peat are two available substances which serve admirably. Not only is the temperature of the soil decidedly reduced, but moisture is kept at the surface as well—two very important considerations in any lily culture, but more especially in the handling of seedlings. In the Virginia situation, spent manure from sweet-potato hotbeds has been put on after the ground has frozen, and been left on during the summer.

The necessity for a summer mulch will always be less pronounced in regions having uniformly low temperatures and reliable optimum moisture conditions.

#### WHEN TO PROPAGATE

The subject of the best time to propagate has received consideration previously in connection with the discussion of the individual species. All that is intended here is to emphasize the great latitude permissible in the time at which propagation may take place in many species.

The species reproduced vegetatively which are considered here have propagated well during or at the close of the blossoming period. (Pl. 6, C, and pl. 7, A.) It seems ruthless to dig a lily in blossom and tear it to pieces, but sentiment must be dismissed. Rapid multiplication of individuals for sale is the goal before us.

It has been shown previously that the species which are imported late in the season can be scaled with success even in December or January under proper protective measures which guard against weather injury.

Again, a good propagation may be effected very early in the season. About two years ago the writer had occasion to clean up a field preparatory to the planting of other crops. A small lot of bulbs of one of the *Speciosum* varieties was in the way. It was dug six weeks before the normal time of flowering, the bulbs were scaled and reset, and the stems heeled in in the field. The result was a perfect propagation from the scales. But every bulb grew with reduced size and there was a small propagation from the stems. In other words, effective scale propagation seems to be possible with some species from July to January without recourse to cold storage.

#### WHEN A LILY IS RIPE

From the botanical viewpoint a lily, like many other plants, may be judged to be "ripe" when the seed has sufficiently developed to harden, turn color, germinate, and grow. But when considered from the viewpoint of the horticulturist, who may not care to produce seed, the question must be differently answered.

It has been shown that good vegetative propagation may be had when the plants are in late blossom, but this does not prove maturity. On the contrary, to dig a lily bulb for propagation and immediate resetting is a very different thing from subjecting it to the vicissitudes of commercial handling for two or three months before it is planted.

It should be borne in mind that lily bulbs dug when the plants are in flower generally will not keep well. There are exceptions, however, particularly in the case of the Madonna lily; but as a rule, lily bulbs are in best maturity when the stems have begun to die or have been killed by the frosts of fall. But an exception should be noted even here, as usually plants which are not allowed to produce seeds die earlier than those which seed, and in some cases the leafage dies before the seed is mature. These and other circumstances seem to show that the bulbs of many lilies have finished their growth before the seed ripens.

To summarize, digging for the market should be done comparatively late in the season, except for the Madonna, the Nankeen, and possibly some other lilies; but the late ones, which are commonly dug while the tops are still green, may be allowed one and one-half to two months' growth after they have flowered before being dug for the market.

Late handling of the bulbs for the market has advantageous factors other than full maturity of the bulbs. Late in the season the temperatures are lower and the desiccating influence of the atmosphere less severe. Heat and drought are the greatest enemies of lily bulbs. These agencies are accountable for all sorts of "diseases."

#### HANDLING SEED AND SEEDLINGS

The production of lilies from seed, when attempted at all, has been looked upon generally as fraught with a great deal of difficulty. Usually it has been thought necessary to start the seed with the extreme nicety of greenhouse or frame culture. There is probably nothing which has been done on the Bellingham, Wash., garden that has created so much surprise among experienced visitors as the planting of seed of so many species of lilies in the open field. But this is a perfectly logical thing to do under the conditions. It is equally logical to do the same thing in other climates if it is possible there to maintain moisture at the surface of the ground long enough to get the seed up. With an overhead sprinkling system, both Regal and Easter lily seed have been grown satisfactorily under open-field conditions on Arlington farm.

Lily seed is grown in the same plots and often interspersed in the same beds with the lily bulbs. Before the seed is planted, however, there is a thorough preparation of the soil. All lily ground is prepared as well as possible with horse tools; then, before the seed is planted the surface is fined and smoothed with a garden rake to get rid of all clods, sods, gravel, and débris which may be in the way. (Pl. 6, A.) The rest of the preparation for the planting is exactly like that for putting the bulbs in, except that the beds for seed planting are excavated only about 1 inch deep, and often rows only 3 inches apart are employed.

Extra care is taken in getting the bottom of the excavated bed smooth, level, and fine. The marker is then run through, placing the

rows accurately across the 3-foot bed. Sometimes a marker is used which lays off rows 3 inches apart and sometimes 6 inches. No recommendations are considered necessary regarding which is preferable, but the writer's experience forces him to favor as thick a planting as is compatible with good growth. The roller marker sinks into the soft ground one-fourth to one-half inch, and the mark is one-half inch or more wide, making a nice depression in which to distribute the seed.

The seed is distributed very effectively and rapidly from cornucopias fashioned from stiff smooth paper. (Pl. 6, B.) Two boys usually accomplish this task, one on either side of the bed. The thickness of seeding varies greatly, but on an average 100 or more seeds are planted to the 3-foot row. This, again, may appear too heavy seeding until one reflects that after all the land is not loaded as heavily by this as by full-sized lily bulbs set 6 inches apart in 9-inch rows. Even when left two years, the quantity of plant material is less in such a seedling bed as described than in a planting of mature bulbs set six to the row. This is a point not usually appreciated. The economy effected by a thick planting should not be overlooked.

The seed is covered by "shoveling" over from the next bed 1 inch of the entire surface soil, as described for bulb planting. The shoveling over of the soil in seed planting is a rather particular job, as it requires careful placement so as not to displace the light seed.

After the seed is covered, the surface is left undisturbed until a crop of weed seed comes up. When the soil has become packed by a rain or two and the first crop of weed seed has germinated, a hoe, a scuffle, or even a wheel hoe may be carefully run over the beds to put the surface in condition. After the lilies begin to come up, weeding is done by hand, a scratcher commonly being used between the narrow rows until the seedlings are large enough to admit of the application of a mulch of short straw, screened peat, or other débris applied to protect the surface of the ground, to unify the temperature, and to reduce evaporation of moisture during the dry season.

It is advisable to protect the surface of the beds with litter, straw, or débris during the first winter after fall seeding. The second winter one-half inch or more of soil should be put over the beds to give the young stock the benefit of added depth. If the paths are wide enough, this can be taken in part at least from them; if they are not, then the soil must be hauled on.

The objection has been raised that all this entails too much labor; but it is much less labor than one would readily bestow on frame planting. Why should it be too much for the field, when it also saves the cost of frames?

In case one has greenhouse or frame and sash facilities and wishes to hurry things up, the seed of all lilies may be sown in flats in late fall, pricked off in second leaf in about three months, and set in the open in the spring as discussed under Regal and Easter lilies.

#### PACKING AND SHIPPING

A few principles need to be kept clearly in mind in getting lily bulbs onto the market. They should not be allowed to dry out; they should not be allowed to accumulate moisture through lack of aera-



tion; they should not mold; they should not be allowed to heat in the pack; they should be kept at as uniformly low temperature as possible; and they should receive no mechanical injuries whatever. To meet these conditions should be the constant concern of the grower, the jobber, and the dealer.

For long voyages there is no better method known than that employed by the Japanese exporters. They put earth (mostly subsoil) under cover in early spring and work it over until it is thoroughly air dried and pulverized before the bulbs are ready to pack. The bulbs are then set in tight boxes in layers alternating with this prepared earth. The bulbs are thus completely surrounded with dry earth, which tends to unify the temperature, prevent evaporation, and reduce the likelihood of bruising. The prevention of evaporation of moisture, which keeps the bulbs from wilting without the risk of molding them through supplying artificial moisture, is the secret of the success of this method. The packing takes place as soon as possible, and preferably as soon as the bulbs are dug and sorted. No "curing" or drying out is allowed. Such a pack is very expensive in freight charges, and therefore need not be employed except for long voyages. Formerly lily bulbs were shipped from Japan incased individually in mud and then packed tightly in boxes. This method is seldom seen to-day.

In domestic handling, where the bulbs can reach their destination by express within a week, such heavy packs are neither necessary nor advisable. For short distances, wrapping in newspaper and packing tightly in boxes is advised. For transportation over longer distances, when the weather is warm or desiccating influences are severe, a lightweight oiled paper may be used in addition, and the bulbs may be packed tightly in boxes in layers alternating with layers of barely moist sphagnum.

Various packing materials may be employed, but they must be of such a nature that they will not absorb moisture from the bulbs. Barely moist fibrous peat or sphagnum work well. Grain chaff or sawdust are all right for Dutch bulbs generally, but they have a tendency to absorb moisture from lily bulbs, and consequently are not advisable except for short-distance shipment.

### PESTS

The writer does not look upon the pests of lilies as unusually formidable. There are a number of them, and they do at times cause damage; but the worst enemies of lily bulbs are neither pathological nor entomological, although fungi and insects are likely to be blamed for much of the havoc wrought by high temperatures, bad soil conditions, exposure, abrasion, and desiccation. These last-named agencies are the worst enemies of the bulbs and are enemies that the bulbs can not withstand. Much of the injury to stocks caused by heat, desiccation, etc., is often mistakenly attributed to associated insect and fungus organisms which may be present and conspicuous, while the real culprits are not in evidence.

In the following paragraphs the principal pathological and entomological enemies of lilies which have appeared during the progress of these investigations are considered.

## BOTRYTIS

Botrytis mold sometimes attacks lilies, especially the Madonna, in garden culture where there is too much shade and consequent poor aeration. In the last 10 years no injury has been observed in private gardens of the Puget Sound region. Botrytis occurred one year in the writer's shaded planting in the District of Columbia. The disease affects the lily much as the same or a closely related organism affects the tulip. The leaves die prematurely, and the buds become moldy and wither. The best preventive is an application of Bordeaux spray frequently enough to maintain a good covering on the foliage. The applications should begin early. Usually, however, the disease gets such a headway before being noticed that a remedy is scarcely practicable, so that all that can be done is to wait until the end of the season, when the stocks can be dug and reset under suitable conditions.

The damping off of seedlings in the seed bed is another manifestation of Botrytis injury. The remedies here are good aeration and proper control of moisture. The plants should be kept on the dry side whenever there is danger. Watering is best done in the morning, so that by evening the plants are comparatively dry. In aggravated cases spraying with one of the organic-mercury compounds will assist in getting rid of the organism and will check the damping off.

No trouble has been experienced with damping off under field conditions, but under greenhouse conditions the case has been very different. The grower who starts his seed in greenhouse or frames should exercise extreme care.

## RUST

The rust fungus (*Uromyces lilii*) is at times very annoying. It manifests itself as minute powdery brown areas on the leaves and stems. These areas may, in severe cases, become confluent into large patches.

The most effective remedies are early and persistent Bordeaux spray and sanitation. All débris of old stems and leaves should be removed from the planting before disintegration takes place. When the crop is dug, all old tops should be left behind and resetting should take place on clean ground.

Some species are much more subject to rust than others. The Madonna, Humboldt, Lemon, and Leopard are particularly susceptible. The native *Lilium columbianum* is badly rusted all through the Northwest. The writer has observed it in various places around Bellingham, Olympia, and Chehalis, Wash., and Portland, Oreg.

## PUFFY LEAF

At times certain lilies exhibit a peculiar dwarfed appearance accompanied by a more or less distorted, thickened, and blistered appearance of the leaves, a condition known as puffy leaf. The growing point of the stem may be killed when the plant, although functioning during the season, remains dwarfed and does not blossom. The leaves are much thicker than normal, owing to the separation in whole or in part of the epidermis, mainly on the lower side, from the tissues beneath. Often the actual separation occurs between the



ribs and at times only in certain areas, which gives unequal tension and causes distortion.

The cause of this condition is late spring frosts. The lilies particularly subject to the influence are Hanson, Regal, and Henry. It is not at all uncommon to find it in *Longiflorum*, *Candidum*, and the *Humboldt* group. Henry is badly affected in the particular location where now grown in the Government garden. It has done well, however, on a ridge 20 feet higher and is a superb lily in at least one favored private garden where it is two weeks later in blossoming than in the Government's location; consequently the plants escape the late frost, through not being so far advanced when it occurs.

#### LIMBER NECK

The stems of many lilies, when grown in moist, shady places, collapse and wilt a few inches below the growing point. This phenomenon (known as limber neck) has been particularly prevalent in the vicinity of the District of Columbia the past season. A similar reaction follows low temperature in late April and early May on Puget Sound in some species.

Recovery will usually take place if the stem is cut off just below the wilted portion, and the remainder of the stem will live and function for the rest of the season. Lilies should have their feet, if at all possible, shaded and their heads should be in the sun. Many of them can not withstand freezing in vegetative condition.

#### BASAL AND EDGE SCALE ROT

Basal and edge scale rot is often a symptom rather than a disease. Abuse of a lily bulb is reflected in the base sooner than anywhere else. It is here that the tissues are most subject to injury when the weakened bulb may be attacked by fungi, mites, or other organisms.

In imported bulbs there are nearly always some rotted bases present. It is often possible to eliminate the trouble by cutting out the decayed portion and allowing the surface to heal. If the bulb is beyond recovery, the scales—if one-half or two-thirds sound—can be cleaned up and a healthy progeny grown from them.

#### APHIDS

Considerable injury occurs at times from the inroads of plant lice (aphids), which attack delicate structures at the apex of the stem, causing malformed parts and distorted or even atrophied flower buds. The Bureau of Entomology recommends a spray of nicotine sulphate, or of a soap solution, or an application of nicotine dust as an effective remedy. The nicotine sulphate should be used in the proportion of 1 part of the 40 per cent nicotine sulphate to 800 parts of water, or one and one-half teaspoonfuls to the gallon. The soap solution is made by dissolving 1 pound of either fish-oil or laundry soap in from 2 to 4 gallons of hot water. The nicotine dust or tobacco powder, to be effective, should contain at least 2 per cent of nicotine.

# ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

February 25, 1928

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